Running head: CALLOUS-UNEMOTIONAL TRAITS AND PAIN RECOGNITION

Recognition of Pain as another Deficit in Young Males with High Callous-Unemotional Traits

Susanne Wolf, B.Sc.[1]

Luna C. Muñoz Centifanti, Ph.D.[1]

[1]Department of Psychology, University of Durham, DH1 3LE, Durham, United Kingdom.

Corresponding Author: Dr. Luna C. Muñoz Centifanti
Department of Psychology
South Road, Mountjoy Site
University of Durham
Durham, DH1 3LE
UK
Phone: +44 1913343245
Fax: +44 1913343241
Email: luna.munoz@durham.ac.uk

In Press, Child Psychiatry and Human Development. The final publication is available at http://link.springer.com. DOI: 10.1007/s10578-013-0412-8

Abstract

Prior research on callous-unemotional traits (CU) supports a deficit in recognizing fear in faces and body postures. Difficulties recognising others' emotions may impair the typical behavioural inhibition for violent behaviour. However, recent research has begun to examine other distress cues such as pain. The present study examined emotion recognition skills, including pain, of school-excluded boys aged 11 to 16 years (N=50). Using dynamic faces and body poses, we examined the relation between emotion recognition and CU traits using the Youth Psychopathic Traits Inventory (YPI) and the Inventory of Callous-Unemotional Traits. Violent delinquency was covaried in regression analyses. Although fearful facial and fearful bodily expressions were unrelated to CU traits, recognition of dynamic pain facial expressions was negatively related to CU traits using the YPI. The failure to replicate a fear and sad deficit are discussed in relation to previous research. Also, findings are discussed in support of a general empathy deficit for distress cues which may underlie the problem behaviour of young males with CU traits.

Recognition of Pain as another Deficit in Young Males with High Callous-Unemotional Traits

A callous disregard of others' feelings and a lack of remorse towards own wrong-doings is characteristic in youth high on callous-unemotional (CU) traits. Further, youth with CU traits appear to be a distinct subgroup of youth with severe, early-onset and difficult-to-treat antisocial behaviour [1-4]. Problems in identifying others' emotional expressions in youth with these traits may explain their inability to empathise with others. Youth with CU tendencies show a distinct deficit in relation to others' distress that is specific to displays of fear [5-7] and sadness [8], which may have consequences for failing to inhibit violent behaviour [9]. Thus, this subgroup of youth may hurt others because they fail to respond to others' distress in a socially appropriate manner.

Research has pinpointed knowing when others are afraid as important in encouraging prosocial behaviour [10, 11]. Individuals who more accurately identified fearful facial expressions were more willing to help others in distress by giving money or their time [11]. Facial emotion expressions appear as the access point to an understanding and vicarious experience of others' emotions [12], and as crucial for an empathic response. Such an understanding is key to the development of empathy, which is "the capacity to think and feel oneself into the inner life of another person" [13, p.82]. Empathy may then elicit an emotionally negative or positive response to another's negative or positive emotional state, and consequently bring about regulation of behaviour [14]. In other words, other people's emotional states may function as a reward [12] or punishment [15].

Indeed, children with CU traits show a reduced response to punishment [16, 17], which in typically-developing samples usually leads to a link of hurtful behaviours to causing distress or disapproval in others. In this way, people learn others' fearful expressions are aversive and so avoid making people afraid. Thus, emotional processing has taken a central

position in current investigations relating CU traits and severe antisocial and aggressive behaviour.

Research has shown, in fact, that children with CU traits have difficulties processing fearful expressions [5, 18]. This fear deficit was found consistently on a wide range of emotional stimuli such as emotional words [19], facial cues [5] and body postures [7]. Further, in a dot-probe paradigm, Kimonis and colleagues [20], in a detained sample of boys (11-18 years), found that aggressive children with CU traits failed to automatically attend to images of distress (e.g., people hurt or crying). In addition, research has shown deficits recognising sad facial expressions in children with CU traits [21]. Therefore, children with CU traits show general deficits to signs of distress in other people.

Notably, regarding its emotional intensity, pain is described as distinct from other basic emotions such as anger, fear, sadness or happiness [22]; yet, pain may be similar to fear in that it provides necessary cues to reinforce prosocial behaviour. More specifically, it is perceived as most threatening or arousing, and yielding a high threat value. Indeed, youths high on CU traits showed reduced activation in parts of the brain involved in empathic responding, as they viewed increasing pain in another person [23]. These regions consisted of the rostral anterior cingulate cortex, ventral striatum, and amygdala. Lockwood et al. [24] also found reduced responses to others' pain in those with CU traits to be related to similar structures (i.e., anterior cingulate cortex). For instance, neural structures such as the amygdala play an important role in empathic responding [25]. Thus, pain may function as part of a social communicative mechanism similar to fear and sadness [26]. That is, other people's displays of pain activate an aversive stimulus reinforcement mechanism, which prioritises avoidance of pain; this implicates the stimulus reinforcement deficits exhibited by youth high on CU traits [10, 16]. Indeed, neural structures such as the amygdala and the anterior cingulate cortex play an important role in stimulus-reinforcement or aversive

conditioning [27].

These important forays into processing of pain represent a further account of the empathic deficits of youths with CU traits. Although prior research has found a negative relation between CU traits (measured as psychopathy) and sensitivity to detect another's pain in adults [30], research has not yet examined behavioural recognition of pain faces as related to CU traits in young males. Therefore in the present study, we aimed to widen our focus to other emotions of distress to include facial expressions of pain. In addition, dynamic faces and body postures were used to better represent real-life communication. The present study examined emotional processing in a sample of young males recruited from alternative schools, where children are referred for behavioural problems. CU traits were assessed using the CU scale of the Youth Psychopathic Traits Inventory (YPI) [31] and also using the Inventory of CU traits (ICU) [32]. Prior research shows deficits in the activation of neural responses to pain are associated with callousness, in particular [24]. The YPI CU was created based on reports of real-life empathy; indeed, it correlates significantly with affective empathy [33]. Additionally, the ICU subscales have been found to correlate with affective empathy, which refers to feeling or sharing in other people's emotions rather than just knowing about other people's emotions (i.e., cognitive empathy) [34]. Violent delinquency was used as a covariate, since conduct problem behaviour has been found to relate to emotional processing and may act as a suppressor variable in some cases of emotional expressions [7]. We only included males, since findings of emotional processing can be inconsistent across gender [6]. We also examined emotion recognition for body and facial expressions.

Further, we used dynamic emotional expressions. In real-life communications, emotional expressions rarely appear static. Recently, videos of real-life experiences are beginning to be used in research [30]. Dynamic emotion expressions reflect different stages

of emotional intensity, specifically the course of emotional expression from neutral to high intensity [22]. Motion of emotional expressions, in addition to shape information, presents a rich display of emotional state. In fact, Wehrle, Kaiser, Schmidt, and Scherer [35] provide evidence that the addition of dynamic information improves emotional processing. However, we expected that emotion recognition skills of dynamic distress signals would be impaired for youth high in CU traits even with the added motion information. Specifically, we hypothesised that youth with high levels of CU traits would show difficulties accurately recognising fearful, sad and pain facial expressions, and fearful and sad bodily expressions.

Method

Participants

Boys attending alternative short stay schools in Lancashire were recruited for participation in this study. Such alternative schooling was provided for youth who were permanently or temporarily expelled from their main stream school because of continuous disruptive behaviour. Three schools were contacted about this study for purpose of recruitment and all three agreed to take part. Head teachers of all three short stay schools gave their consent *in loco parentis* as target age range of youth was 11 to 16 years of age. In addition, and because most participants were still under the age of 16, information on the study was sent to the parents who then had a period of two weeks when they could opt out of the study. None of the parents objected, so each boy within the age range was approached individually by school staff to ask for their assent. In total, 52 boys were asked to participate across the three schools and 50 boys (98%) between the age of 11 to 16 (mean age=14.3; SD=1.2) agreed to participate.

The majority of the final sample of 50 boys were of White British ethnicity (89.2%) followed by a smaller percentage of youth of Pakistani (5.4%), Indian (2.7%) and White Caribbean (2.7%) backgrounds. Further, the majority of participants reported that they grew

up living with their biological father and mother (59.5%) followed by living with biological mother alone (24.3%). With regard to family size, 48.6% of the participants reported living with none, one or two siblings, and 51.2% reported living with three or more siblings.

Measures

Callous-Unemotional Traits. Callous-unemotional traits were assessed using two screening tools for use with youths. The Youth Psychopathic Traits Inventory (YPI) [31] was developed as a measure for psychopathic traits for youth from the age of 12 years in the general population [36]. The YPI has been found to be uniquely different from other CU assessments, such that items are worded as neutral or even as a beneficial trait (e.g. "I usually feel calm when other people are scared") instead of being worded as a deficit. This was intended to encourage youth to endorse the items. The YPI is divided into 10 subscales of five items each: interpersonal (lying, manipulation, grandiosity and dishonest charm); affective (callousness, unemotionality and remorselessness); and behavioural (impulsivity, thrill-seeking and irresponsibility). According to confirmatory and exploratory factor analysis, the 50 items of the YPI load on three interrelated factors: 1) Grandiose/Manipulative, 2) Callous/Unemotional and 3) Impulsive/Irresponsible [31, 36, 37]. Participants rated each item on a 4-point Likert-type scale ranging from "Does not apply very well" (1) to "Applies very well" (4). The sum of the final scores of the CU subscale for each participant was used for data analysis. Total scores of the YPI CU could range between 0 and 60 with a higher score reflecting greater levels of CU traits. Internal consistency of the CU subscale of the YPI was moderate with α=.60 and similar to prior research [31].

Participants also completed the 24-item Inventory of Callous-Unemotional Traits (ICU) [32]. The scale is rated on a four-point Likert scale indicating 0 'not at all true' to 3 'very true'. The ICU has been validated in adolescent community samples across different cultures [38, 39, 40], and in juvenile offenders in the United States but eliminating items 2

and 10 [41]. In all samples, a similar factor-structure emerged with three factors (e.g., Uncaring, Callousness, Unemotional) loading on a higher-order CU dimension. Importantly, the total scores proved to be internally consistent in these samples (coefficient alpha .77 to .89) and they were related to antisocial behaviour, aggression, delinquency, various personality dimensions, and psychophysiological measures of emotional reactivity in ways consistent with past research on CU traits. The items were summed, excluding items 2 and 10. Total scores on the ICU could range between 0 and 66 with higher scores reflecting greater levels of CU traits.

Self-report of Violent Delinquency. Participants reported on their violent delinquency using eight items from the Self-Report of Delinquency Scale (SRD) [42]. Participants were required to answer 'yes' (1) or 'no' (0) on whether they have engaged in violent behaviour against others (teachers, students or others) in the past (e.g. "Have you ever hit (or threatened to hit) a teacher or other adult at school?"). Specifically, items also asked about whether they were violent with the intent to harming others (e.g., " Have you ever attacked someone with the idea of seriously hurting or killing him or her?") or obtaining things (e.g., "Have you ever used force (strong-arm method) to get money or things from other students?"). The self-reported violence measure then presented one variable of violent delinquency by summing of violent acts committed with a possible range of zero to eight [43]. Items were developed based on all offenses reported by the Uniform Crime Report where juvenile offense rate was greater than 1% [44]. The violent subscale of the SRD [42] used in this study presented an adequate internal consistency of α=.56 similar to prior research (e.g., α=.61) [41].

Emotion Recognition. Emotion recognition skills were assessed from two sets of dynamic stimuli presenting facial expressions and postures of emotions. Emotional displays were presented randomly but maintaining the faces and postures separate. Participants

responded to the emotional videos given a set of options of emotional labels. The decision to use forced-choice response was consistent with prior emotion recognition research [7]. Participants could respond at any point following the start of the video. Videos were presented using E-Prime 2. The presentation was programmed in a way so the display of the next emotional face or posture could only happen upon the participants' response. Response time data therefore was not limited. That is, participants could take as much time as they wanted to respond to the presentation of expressions. However, participants were asked to make an intuitive and relatively quick decision. Emotion recognition accuracies by emotion were collected.

A) Facial stimuli were presented to participants as a series of one-second dynamic visual stimuli of faces of four female and four male trained actors [22]. Emotions displayed by these actors included fear, pain, anger, happiness, disgust, and sadness. The actors were instructed to imagine personal situations when they might have felt similar emotions; they were also shown images of prototypical facial emotional expressions to record the videos. The nature of a dynamic presentation of emotions has allowed the display of a course of an emotional expression starting with a neutral face and ending at the peak of the emotion expression. Expressions were prototypical because they were identified as possessing key features of Ekman's and Friesen's [45] Facial Action Coding System (FACS). In the present study, a set of four videos for each emotion was presented with two female and two male actors each. Videos of emotional faces for each emotion were chosen with reference to how reliably these emotions were recognised according to intensity, valence and arousal and were further standardised within a pilot sample of young healthy adults [22]. Previous research that involved healthy young adults have shown mean recognition rates of 85% and 86% of the dynamic face expression demonstrating reliable and discriminative features [46, 22 respectively]. For the present sample, we encountered an investigator error which resulted in

the exclusion of the face recognition data of 13 participants.

B) Body poses were presented to participants in addition to facial expressions of emotions making use of a series of three-second video clips of emotions in patch-light condition [47]. In this condition, main body parts (e.g., hands, face, knees) are represented by patches of light, which are the only visible elements in the video. When static, the seemingly unconnected dots appear meaningless; in motion, however, they give the viewer an impression of a moving body. Actors were instructed, similar to the development of the facial videos, in their performance to ensure interpretations of how to express one emotion, and for the purpose of the emotional poses to appear spontaneous. Although the patch-light expressions have not been used with youth, previous research has shown good discriminative features of these bodily emotion expressions and better accuracies than static full-light expressions with a sample of young adults [47]. So, the use of patch-lights in motion was confirmed to be a valid display of dynamic emotional body poses. Patch-light video in contrast to full-light videos contain unconfounded motion information while excluding any static or form information [48]. Specifically, age information was not displayed, so that participants could not tell whether emotions were acted out by adults or same-aged peers. Emotional postures used were fear, anger, happiness, disgust, and sadness. Because the facial expressions and the set of postures were developed separately, only the facial set included painful expressions. Videos of emotional postures similar to the facial expressions were chosen from this database with reference to how reliably these emotions were accurately recognised (>80%) [47]. So that a set of four videos for each emotional posture was presented showing two female and two male actors. Finally due to fatigue, three participants did not finish the posture recognition task, and were subsequently excluded from analyses of the emotional posture recognition accuracy.

Procedure

The study was carried out under the approval of the ethics committee of the University of Central Lancashire. No incentives were provided for taking part. Following the participants' verbal consent to take part, the youth were brought into a quiet room within the school to complete the YPI and ICU as well as the violent delinquency items. On completion of the questionnaires, the youths were asked to complete the emotion recognition task, which included a set of emotional facial and emotional posture expressions. Both sets were presented to the youth while counterbalancing for order.

Data Analytic Strategy

For the purpose of comparing present findings to that of prior investigations, unbiased participants' rate of correct responses that would take response bias into account was calculated by the following method. The squared correct response was taken and divided by the product of the response bias (i.e. emotion label) and the number of stimuli for each emotion in each set. Indeed, both YPI CU and ICU were related to the more frequent use of the label of faces as angry, r=.49, p<.01 and r=.42, p<.01, respectively. The YPI CU was negatively related to the use of disgust in labelling faces, r=-.39, p<.05. Additionally, corrected response to happy face recognition appeared skewed and would not converge with the model. For further analyses, only happy face recognition was normalised using a log transformation by taking the natural logarithm.

To determine if CU traits were related to deficits in recognition of distressful emotional expressions (i.e., fear, pain, and possibly sadness), hierarchical multiple regressions were conducted using Mplus 7.11 [49]. Fully saturated models with manifest variables were run separately for facial expressions and postures. The first model included two steps, regressing ICU and YPI CU on age and violent delinquency, and then adding the

accuracy for the six facial emotions[1]. Significant improvement of the model fit was examined to see if emotion recognition measures significantly predicted CU traits after accounting for the covariates.

Results

Table 1 shows the descriptive statistics of the main study variables. Due to the skewness of happy facial expression accuracy, a log transformation was conducted prior to further analyses. Zero-order correlations between the covariates and demographic measures showed that increasing age was related to less accuracy in recognizing anger in faces, r=-.45, p<.01. Thus, age and violent delinquency were both used as covariates.

The first step of the regression resulted in significant prediction of the YPI CU, β=.38, SE=.12, t= 3.16, p<.01, 95%CI = .15 to .62, and the ICU, β=.34, SE=.13, t= 2.71, p<.01, 95%CI = .09 to .58, from violent delinquency. Further, YPI CU and ICU were positively correlated in the model (see Figure 1), though the effect size was weak (r=.26, p<.05). The variance explained (R^2) was .15 for the YPI CU and .12 for the ICU, which were both non-significant. The addition of the facial emotion recognition measures resulted in a significant improvement of the model fit, Δ-2LL (Δdf=12) = 91.16, p<.001. The standardized solution of the final model is summarised in Figure 1. This showed accuracy for pain negatively statistically predicted CU traits (measured by YPI CU), β= -.41, SE=.23, t= -1.99, p<.05, 95%CI = -.81 to -.01. Additionally, examining the responses revealed that pain was most often misidentified as sadness and disgust. The resulting variance including all predictors and covariates was significant in explaining YPI CU scores, R^2=.36, SE=.13, t= 2.87, p<.01. Unexpectedly, for ICU, only accuracy of angry faces was significantly and *positively*

[1] In order to examine whether a covariance between ICU and YPI CU would explain the association between emotion recognition and CU traits, the two scales of CU traits were entered into one model (two models: one each for faces and postures). Results were not substantively different to entering YPI CU and ICU separately (that is, four models). Thus, for the sake of simplicity, we used the former model, which allowed for the covariance between ICU and YPI CU.

associated with CU traits, β=.36, SE=.17, *t*= 2.18, *p*<.05, 95%CI = .04 to .69. This is similar to research on adult psychopathic criminals [50]. The variance explained for the ICU was marginally significant, R^2=.24, SE=.12, *t*= 1.96, *p*=.05. Finally when including emotional faces in the model, violent delinquency was significantly associated with YPI CU traits, β= .36, SE=.13, *t*= 2.66, *p*<.01, 95%CI = .09 to .62, but was no longer significantly associated with ICU scores, β= .18, SE=.15, *t*= 1.21, *p*=.23, 95%CI = -.11 to .48. Therefore, deficits in recognising painful facial expressions were related to the measure of CU traits (measured by YPI CU), which was also uniquely related to violence. However, ICU scores were no longer significantly associated with violent delinquency after including emotional faces, possibly because of the strong association with accuracy in recognising anger.

The second model examined CU traits and accuracy for emotion recognition in postures. We regressed CU traits onto accuracy for all five emotional postures. The model fit improved significantly with the addition of the accuracy for emotional poses, Δ-2LL (Δdf=10) = 35.30, *p*<.001. The results of the final model (as standardised values) are summarised in Figure 2. Similar to prior research with the ICU [7] a significant and negative association between YPI CU scores and angry posture recognition was found, β= -.41, SE=.17, *t*= -2.47, *p*<.05, 95%CI = -.73 to -.08. Examining the most frequent responses for anger revealed that it was most often misidentified as happy followed by disgust. Interestingly, accuracy for happy postures was significantly and positively associated with YPI CU scores, β=.33, SE=.15, *t*= 2.21, *p*<.05, 95%CI = .04 to .63, even when accounting for response biases in labelling. The resulting variance explained in YPI scores for the final model was significant, R^2=.32, SE=.11, *t*= 2.82, *p*<.01. Unexpectedly, for ICU scores, accuracy for disgust was significantly and positively associated with CU traits, β=.44, SE=.12, *t*= 3.70, *p*<.001, 95%CI = .21 to .67. The variance explained in the ICU scores was significant, R^2=.38, SE=.11, *t*= 3.41, *p*<.001. Further, delinquency was significantly

associated with both YPI CU scores, β=.46, SE=.11, t= 4.10, p<.001, 95%CI = .24 to .68, and ICU scores, β=.40, SE=.11, t= 3.59, p<.001, 95%CI = .18 to .62. Thus, for YPI CU, deficits were shown in recognising the negative emotion of anger in postures and pain in faces. However, ICU showed enhancements in recognising disgust in postures and anger in faces.

Discussion

The present study is the first known study to demonstrate behavioural deficits in relation to pain-recognition for youths high on CU traits (measured with the YPI). Given the importance of distress cues for social interactions, the present study supports a model of impaired emotional processing of distress for youths high on CU traits [15]. The ICU showed relations with accuracy for recognising anger in faces. Indeed, in the hierarchical model, violent delinquency was no longer related to the ICU once recognition of anger was included in the model. Like research showing enhancements for anger-recognition in criminal populations and in criminal people with psychopathy [50], CU traits (using the ICU) in our sample of excluded young males may be related to violent delinquency due to the enhanced ability to recognise anger.

Our findings showed a specific deficit for facial expressions of pain in boys with higher levels of CU traits. Generally, facial emotion expressions are considered the first communication margin that, when accurately processed, can lead to an empathic response [12]. Importantly, the processing of emotion expressions is thought to be complemented by a vicarious emotional experience as a supportive mechanism of the observations [951]. Recent research has confirmed a low empathic response to seeing others' pain for people with CU features [23, 24]. Further, prior research shows reduced anticipation of and reactivity to pain stimuli in people with high CU traits (measured as psychopathy) [30, 52]. In other words, people high on CU traits may not understand the pain experiences of other people [15] because of a lack of vicarious emotional experience [53]. Indeed, Caes and colleagues [30]

showed that psychopathy was related to less sensitivity in detecting another person's pain. This suggestion is also supported by neuroimaging research. Such research has identified a reduced activation of neural structures involved in processing and vicariously experiencing other people's pain for those with high CU traits [23]; these same structures, such as the anterior cingulated cortex and insula [54] as well as the amygdala and ventromedial prefrontal cortex for processing of male faces [55], have been found to be involved in the first-hand experience of pain [56, 57]. Indeed, very recent research suggested that while psychopathic individuals showed normal activation of these brain regions when they imagined pain to themselves, these regions showed a reduced activation when they imagined pain to others [58]. Therefore, youths high on CU traits may show difficulties processing painful facial expressions due to their own low empathic response to others' pain [24].

Our results may be interpreted as supporting the Violence Inhibition Mechanism (VIM) [15]. Although pain has not been considered in this context, painful facial expressions may serve a similar function as aversive stimuli (such as fear) and consequently regulate or inhibit behaviour. The function of distressful emotional expressions may then act as "behaviour regulators" [14]. Therefore, difficulties processing painful facial expressions in boys high on CU traits may be evidence of a failing behaviour regulator. Prior research on interpersonal violence among adult couples has shown that violent husbands misperceive fear in their wives: often, fear was misidentified as disgust. If fearful emotional expressions are misperceived as expressions of disgust, then emotions that typically act as inhibitors to violence, may be construed as a social rejection [59]. In the present study, pain was often misidentified as disgust. Thus, youths high on CU traits may perceive rejection when others are actually in pain, which may account for their aggressive and bullying behaviour [34]. However, because we were not able to replicate the fear processing deficit that has been found in prior research, this remains a suggestion to test in the future.

Our central finding in this study was two-fold. Firstly, general distress-processing deficits may be implicated in a CU-specific trajectory of antisocial and aggressive behaviour. That is, research exists showing that youths with CU traits experience deficits in general emotional processing of distress cues, such as scenes of sadness, fear, and pain [20]. The results of the present study were consistent with expectations that distress emotions (e.g., pain) would be associated with CU traits. Secondly and in contrast to our expectations, the specific distress emotion (i.e., fear) that has been consistently found to be related to CU traits in prior research [60] was not found. Some research has failed to show a deficit in fear recognition for youths high on CU traits using facial expressions [61, 62, 63]. Inconsistencies between our findings and those of prior research may be because of differences between samples. Similar to another study [63] that did not find a fear deficit, we recruited an adolescent sample who were referred for antisocial behaviour to an alternative school [63, used a treatment program]. Research that has found a fear and sad deficit [7] used a community sample from deprived backgrounds, but were not referred for antisocial behaviour. Because our sample showed high levels of violence, our null findings may have reflected a comorbidity problem that we had not accounted for. Specifically in previous research, problem behaviour was found to highly overlap with impulsivity problems [64]. Furthermore, youth with problems of impulse control have demonstrated a greater sensitivity and faster reactivity to negative emotional stimuli than youth with CU tendencies [65]. Given that we did not control for impulsivity problems in the present study, failure to replicate a fear or sad deficit may reflect that a high proportion of youth in the sample had impulse control problems. Indeed, Waschbusch and Woodworth [63] previously found that youth with high levels of CU traits had difficulties recognising sad faces and a trend for fear faces after controlling for impulsivity problems (e.g. Attention Deficit Hyperactivity Disorder). This suggests future research should include a measure of impulse control.

Additionally, facial expressions of pain may be more arousing and possess a greater threat value than fear, and attention to such painful stimuli may be more dependent on a vicarious emotional experience as part of an evolutionary and biological protective system [26]. More specifically, pain is perceived as most threatening or arousing indicating a more imminent threat. Further, pain is described as an emotion distinct from other basic emotions such as anger, fear, sadness, and happiness [22]. Thus, discrepancies in findings across studies require further investigation. Future research would benefit from the use of physiological measures to examine the potential vicarious experience that accompanies emotional processing. For example, recent research finds CU traits (measured by the ICU) are related to less fear sensitivity [66]; thus, it could be CU traits are related to reduced levels of physiological arousal when viewing others in pain [24, 30].

In contrast to prior research that involved a similar sample of antisocial youth [7], CU traits (measured with the ICU) were related to better recognition of anger and disgust in the present study. However, our findings are consistent with other research on adults with psychopathy, where they showed high false alarm rates to angry faces [50, 59]. Indeed, our findings showed greater use of the "anger" label for those with CU traits. Although we corrected our accuracy measures by taking labelling bias into account, it could be this bias still had an effect. In studies of adult psychopathy, a good ability to detect disgust and anger was related to violence [8, 50, 59]. Our findings also indicated that violence was no longer significantly related to CU traits once emotion recognition measures, including anger, were included in the model. This suggests enhancement of anger identification in young males with CU traits may account for their violent behaviour. Consistent with these findings, CU traits (ICU) in youths have been associated with violence and aggression in numerous studies [4, for a review]. Another surprising finding in our study was a positive relation between the YPI CU subscale and recognition of happy postures. In contrast, the same YPI subscale was

related to a reduced ability to recognise angry postures: these were most often labelled as happy. Anger and happiness displayed in the dynamic bodily expressions were the most kinetic of movements. It could be that youths high on CU traits (YPI) misperceive subtle differences between emotions when information about form and shape are not able to be used.

In real-life communications, facial expressions are typically accompanied by gestures such as hand, upper body or head movements, which allow for further contextual information to be processed by the viewer. Although having this contextual information may assist in processing emotional expressions [35], prior research has found youths high on CU traits experience deficits in processing fearful bodily expressions [7]. This may suggest an emotion processing deficit that is not isolated to recognition of emotional faces, and which may have implications for behavioural outcomes [15]. Atkinson and colleagues [47, 67] have found that patch-light, in contrast to full-light whole body emotional expressions, were generally less accurately identified, providing greater variance in recognition. The intention of using only motion information of emotions was to amplify any specific emotion-processing deficit in relation to CU traits. However, the patch-light task was very difficult as evidenced by the means; this may have contributed to the differences between our findings and those of other studies that have used static faces or postures [5, 7].

The findings from the present study must be interpreted in light of some limitations. Following the presentation of each dynamic facial expression video, the expressions froze. For example, participants could take as much time as they wanted to press any of the keys labelling the displayed expression while the frozen picture was there. Therefore, the findings of the present study reflect emotion recognition not solely for dynamic expressions, but participants could have made use of the final static expressions to aid them. Additionally, the small sample size may have limited our power to find significant effects for fear. Also for

face recognition, the data of 13 participants were unavailable for data analyses reducing the sample size for face recognition even further. However, consistent with prior research, we did find significant deficits for pain and anger. Finally, dynamic facial as well as patch-light body expressions have not been validated with youth prior to the present study. Specifically, emotional faces were acted out by adults for the present study. However, prior research involving a similarly-aged sample [7] has found deficits in fear for youths high on CU traits using static pictures of adult faces. This suggests that youths high on CU traits may show deficits in recognising distress emotions in adult faces. The use of dynamic faces and postures was an improvement because only static pictures of adult faces and postures have been used with youth [7].

Future research should include measures of anxiety which were not included in the present study. Prior research has shown deficits in emotional processing of distress cues in youths with high levels of violence, community violence exposure and CU traits [20] that is specific to a high-anxiety variant of CU traits [68].

The present study also had some important strengths. First, our use of dynamic emotional expressions is more ecologically valid than the use of static pictures, which have been traditionally been used in prior research. We also included another facial expression (i.e., pain) that may show behavioural deficits. Further, we included two measures of CU traits to examine the generalisation of results across different screening tools. Our findings indicate the YPI CU exhibited expected relations with emotional processing. Finally, our results suggest dynamic faces and postures show similarities with prior research. Our results also add to the understanding of deficits in understanding distress cues as key to the callous-unemotional personality type.

Therefore, our findings could inform implications for treatment or early intervention for children with high CU traits that centres around improving emotion recognition skills. In

other words, training on perception and interpretation of human emotions may foster empathy skills. Indeed, when compared to treatment-as-usual, training on perception and interpretation of human emotions resulted in improvements in parent-reported affective empathy for children with CU traits [69]. Other alternative treatment for juvenile offenders aims to improve understanding of social and emotional interpersonal cues and consideration for others [70, 71, 72]. Such treatment was found to reduce interpersonal callousness and predicted improved institutional behaviour and motivation to take part in the treatment over time [71, 72]. Our findings suggest that such training, which focuses on empathy skills and consideration for others by improving emotion recognition, may be warranted. Finally, our findings point towards a general deficit in interpreting negative emotions rather than a specific fear or sad deficit that may underlie the antisocial behaviour of youth high on CU traits.

Summary

In sum, we aimed to broaden the scope of impairment for youths high on CU traits to include other signals of distress besides sadness and fear, such as facial expressions of pain. Our findings did not replicate a specific deficit to fearful faces or body expressions. Instead, our findings point to a broad impairment for processing negative emotions in youth high in CU traits. Specifically, problems recognising pain faces and angry body expressions were negatively associated with CU traits in a group of antisocial boys who were 11 to 16 years old. Therefore, the present research supports a general empathy deficit to others' distress signals in youth high on CU traits, which may underlie the violent behaviour that is associated with CU traits.

References

1. Frick PJ, Dickens C (2006) Current perspectives on conduct disorder. Curr Psychiatry Rep 8(1): 59-72
2. Frick PJ, Stickle TR, Dandreaux DM, Farrell JM, Kimonis ER (2005) Callous–unemotional traits in predicting the severity and stability of conduct problems and delinquency. J Abnorm Child Psychol33(4): 471-487
3. Frick PJ, White SF (2008) Research Review: The importance of callous-unemotional traits for developmental models of aggressive and antisocial behaviour. J Child Psychol Psychiatry 49(4): 359-375
4. Muñoz LC, Frick PJ (2012) Callous-unemotional traits and their implication for understanding and treating aggressive and violent youths. Crim Justice Behav 39(6): 794-813
5. Dadds MR, Perry Y, Hawes DJ, Merz S, Riddell AC, Haines DJ, Solak E, Abeygunawardane AI (2006) Attention to the eyes and fear-recognition deficits in child psychopathy. Br J Psychiatry 189(3): 280-281
6. Dadds MR, El Masry Y, Wimalaweera S, Guastella AJ (2008) Reduced eye gaze explains “fear blindness” in childhood psychopathic traits. J Am Acad Child Adolesc Psychiatry 47(4): 455-463
7. Muñoz LC (2009) Callous-unemotional traits are related to combined deficits in recognizing afraid faces and body poses. J Am Acad Child Adolesc Psychiatry 48(5): 554-562
8. Blair RJR, Colledge E, Murray L , Mitchell D (2001) A selective impairment in the processing of sad and fearful expressions in children with psychopathic tendencies. J Abnorm Child Psychol 29(6): 491-498
9. Blair RJR (2001) Neurocognitive models of aggression the antisocial personality

disorders and psychopathy. J Neurol Neurosurgery Psychiatry 71(6): 727-731

10. Blair RJR, Peschardt K, Budhani S, Mitchell D, Pine D (2006) The development of psychopathy. J Child Psychol Psychiatry 47(3-4): 262-276
11. Marsh AA, Kozak MN, Ambady N (2007) Accurate identification of fear facial expressions predicts prosocial behaviour. Emotion 7(2): 239-251
12. Niedenthal PM, Brauer M (2012) Social functionality of human emotion. Annual. Annu Rev Psychol 63: 259-285
13. Kohut H (1984) Introspection empathy and semicircle of mental health. Emotions Behavior Monographs 3: 347-375
14. Campos JJ, Thein S, Owen D (2003) A Darwinian legacy to understanding human infancy. Ann N Y Acad Sci 1000(1): 110-134
15. Blair RJR (1995) A cognitive developmental approach to morality: investigating the psychopath.. Cognition 57(1): 1-29
16. Blair RJR (2004) The roles of orbital frontal cortex in the modulation of antisocial behaviour. Brain Cogn 55(1) :198-208
17. Centifanti LCM, Modecki K (2013) Throwing Caution to the Wind: Callous-Unemotional Traits and Risk Taking in Adolescents. J Clin Child Adolesc Psychol 42(1): 106-119
18. Blair RJR, Mitchell DGV, Peschardt KS, Colledge E, Leonard RA, Shine JH, Murray LK, Perrett DI (2004) Reduced sensitivity to others' fearful expressions in psychopathic individuals. Personality and Individual Differences 37(6): 1111-1122
19. Loney BR, Frick PJ, Clements CB, Ellis ML, Kerlin K (2003) Callous-Unemotional Traits Impulsivity and Emotional Processing in Adolescents With Antisocial Behavior Problems. J Clin Child Adolesc Psychol 32(1) :66-80
20. Kimonis ER, Frick PJ, Muñoz LC, Aucoin KJ (2007) Can a laboratory measure of

emotional processing enhance the statistical prediction of aggression and delinquency in detained adolescents with callous-unemotional traits? J Abnorm Child Psychol 35(5): 773-785

21. Blair RJR, Coles M (2000) Expression recognition and behavioural problems in early adolescence. Cogn Dev 15(4): 421-434
22. Simon D, Craig KD, Gosselin F, Belin P, Rainville P (2008) Recognition and discrimination of prototypical dynamic expressions of pain and emotions. Pain 135(1): 55-64
23. Marsh AA, Finger EC, Fowler KA, Adalio CJ, Jurkowitz IT, Schechter JC, Blair RJR (2013) Empathic responsiveness in amygdala and anterior cingulate cortex in youths with psychopathic traits . J Child Psychol Psychiatry 54 (8): 900-910
24. Lockwood PL, Sebastian CL, McCrory EJ, Hyde ZH, Gu X, De Brito SA, Viding E (2013) Association of Callous Traits with Reduced Neural Response to Others' Pain in Children with Conduct Problems. Curr Biol 23(10): 901-905
25. Decety J, Michalska KJ (2010) Neurodevelopmental changes in the circuits underlying empathy and sympathy from childhood to adulthood. Dev Sci 13(6): 886-899
26. Craig KD (2009) The social communication model of pain. Canadian Psychology 50(1): 22-32
27. Kosson D, Budhani S, Nakic M, Chen G, Saad Z, Vythilingam M, Pine DS, Blair RJR (2006) The role of the amygdala and rostral anterior cingulate in encoding expected outcomes during learning. Neuroimage 29(4): 1161-1172
28. Craig KD, Patrick CJ (1985) Facial expressions during pain. J Pers Soc Psychol 48(8): 1080-1091
29. Prkachin KM (1992) The consistency of facial expressions of pain: a comparison

across modalities. Pain 51(3): 297-306

30. Caes L, Uzieblo K, Crombez G, De Ruddere L, Vervoort T, Goubert L (2012) Negative emotional responses elicited by the anticipation of pain in others: psychophysiological evidence. J Pain 13(5): 467-476
31. Andershed HA, Kerr M, Stattin H, Levander S (2002) Psychopathic traits in non-referred youths: A new assessment tool In E Blaauw L Sheridan (Eds) Psychopaths—Current international perspectives Den Haag: Elsevier
32. Frick PJ (2004) The Inventory of Callous-Unemotional Traits [Unpublished rating scale]
33. Dolan MC, Rennie CE (2007) The relationship between psychopathic traits measured by the Youth Psychopathic trait Inventory and psychopathology in a UK sample of conduct disordered boys. J Adolesc 30(4): 601-611
34. Muñoz LC, Qualter P, Padgett G (2011) Empathy and bullying: exploring the influence of callous-unemotional traits . Child Psychiatry Hum Dev 42(2): 183-196
35. Wehrle T, Kaiser S, Schmidt S, Scherer KR (2000) Studying the dynamics of emotional expression using synthesized facial muscle movements. J Pers Soc Psychol 78(1): 105-119
36. Andershed H, Hodgins S, Tengström A (2007) Convergent Validity of the Youth Psychopathic Traits Inventory (YPI) Association With the Psychopathy Checklist: Youth Version (PCL: YV). Assessment 14(2): 144-154
37. Rennie CE, Dolan MC (2010) The significance of protective factors in the assessment of risk. Crim Behav Ment Health 20(1): 8-22
38. Essau CA, Sasagawa S, Frick PJ (2006) Callous-unemotional traits in a community sample of adolescents. Assessment 13(4): 454-469
39. Fanti KA, Frick PJ, Georgiou S (2009) Linking callous-unemotional traits to

instrumental and non-instrumental forms of aggression. J Psychopathol Behav 31(4): 285-298

40. Roose A, Bijttebier P, Decoene S, Claes L, Frick PJ (2010) Assessing the affective features of psychopathy in adolescence: A further validation of the Inventory of Callous and Unemotional Traits. Assessment 17(1): 44-57
41. Kimonis ER, Frick PJ, Skeem JL, Marsee MA, Cruise K, Muñoz LC, Aucoin KJ, Morris AS (2008) Assessing callous-unemotional traits in adolescent offenders: Validation of the Inventory of Callous-Unemotional Traits. Int J Law Psychiatry 31(3): 241-252
42. Elliott DS, Ageton SS (1980) Reconciling race and class differences in self-reported and official estimates of delinquency. American Sociological Review 45: 95-110
43. Krueger RF, Schmutte PS, Caspi A, Moffitt TE, Campbell K, Silva PA (1994) Personality traits are linked to crime among men and women: evidence from a birth cohort. J Abnorm Psychol 103(2): 328-338
44. Elliott DS, Huizinga D (1983) Social class and delinquent behavior in a national youth panel: 1976–1980. Criminology 21(2): 149-177
45. Ekman P, Friesen WV (1976) Pictures of facial affect. Consulting Psychologist Press: Alto (CA)
46. Collignon O, Girard S, Gosselin F, Roy S, Saint-Amour D, Lassonde M, Lepore F (2008) Audio-visual integration of emotion expression. Brain Research 1242: 126-135
47. Atkinson AP, Dittrich WH, Gemmell AJ, Young AW (2004) Emotion perception from dynamic and static body expressions in point-light and full-light displays. Perception 33: 717-746
48. Johansson G (1973) Visual perception of biological motion and a model for its analysis. Percept Psychophys 14(2): 201-211

49. Muthen LK, Muthén L (1998) Mplus [computer software] Los Angeles CA: Muthén Muthén

50. Iria C, Barbosa F, Paixao R (2008) Reduced galvanic skin responses to facial expressions of emotions in psychopaths: An exploratory study. Int J Psychophysiol 69(3): 268

51. Olsson A, Phelps EA (2004) Learned fear of "unseen" faces after Pavlovian observational and instructed fear. Psychol Sci 15(12): 822-828

52. Hare RD (1965) Psychopathy fear arousal and anticipated pain. Psychol Rep 16(2): 499-502

53. Yamada M, Decety J (2009) Unconscious affective processing and empathy: An investigation of subliminal priming on the detection of painful facial expressions. Pain 143(1): 71-75

54. Botvinick M, Jha AP, Bylsma LM, Fabian SA, Solomon PE, Prkachin KM (2005) Viewing facial expressions of pain engages cortical areas involved in the direct experience of pain. Neuroimage 25(1): 312-319

55. Simon D, Craig KD, Miltner WH, Rainville P (2006) Brain responses to dynamic facial expressions of pain. Pain 126(1): 309-318

56. Jackson PL, Meltzoff AN, Decety J (2005) How do we perceive the pain of others? A window into the neural processes involved in empathy. Neuroimage 24(3): 771-779

57. Lamm C, Meltzoff AN, Decety J (2010) How do we empathize with someone who is not like us? A functional magnetic resonance imaging study. J Cogn Neurosci 22(2): 362-376

58. Decety J, Chen C, Harenski C, Kiehl K (2013) An fMRI study of affective perspective taking in individuals with psychopathy: imagining another in pain does not evoke empathy. Front Hum Neurosci 7:489

59. Marshall AD, Holtzworth-Munroe A (2010) Recognition of wives' emotional expressions: A mechanism in the relationship between psychopathology and intimate partner violence perpetration.. J Fam Psychol 24(1): 21-30

60. Marsh AA, Finger EE, Schechter JC, Jurkowitz ITN, Reid ME, Blair RJR (2011) Adolescents with psychopathic traits report reductions in physiological responses to fear. J Child Psychol Psychiatry 52 (8): 834-841

61. Kosson DS, Suchy Y, Mayer AR, Libby J (2002) Facial affect recognition in criminal psychopaths. Emotion 2(4): 398-411

62. Glass SJ, Newman JP (2006) Recognition of facial affect in psychopathic offenders. J Abnorm Psychol 115(4): 815-820

63. Woodworth M, Waschbusch DA (2008) Emotional processing in children with conduct problems and callous/unemotional traits. Child Care Health Dev 34: 234-244

64. Waschbusch DA (2002) A meta-analytic examination of comorbid hyperactive-impulsive-attention problems and conduct problems. Psychol Bull 128(1): 118-150

65. Loney BR, Frick PJ, Clements CB, Ellis ML, Kerlin K (2003) Callous-unemotional traits, impulsivity, and emotional processing in adolescents with antisocial behaviour problems. J Clin Child Adolesc Psychol 32(1): 66-80

66. Roose A, Bijttebier P, Van der Oord S, Claes L, Lilienfeld SO (2013) Psychopathic Traits in Youth and Associations with Temperamental Features. Journal of Individual Differences 34(1): 1-7

67. Atkinson AP, Heberlein AS, Adolphs R (2007) Spared ability to recognise fear from static and moving whole-body cues following bilateral amygdala damage. Neuropsychologia 45(12): 2772-2782

68. Kimonis ER, Frick PJ, Cauffman E, Goldweber A, Skeem J (2012) Primary and secondary variants of juvenile psychopathy differ in emotional processing. Dev

Psychopathol 24(3): 1091-1103

69. Dadds MR, Cauchi AJ, Wimalaweera S, Hawes DJ, Brennan J (2012) Outcomes moderators and mediators of empathic-emotion recognition training for complex conduct problems in childhood. Psychiatry Res 199(3): 201-207
70. Caldwell M, Skeem J, Salekin R, Van Rybroek G (2006) Treatment response of adolescent offenders with psychopathy features: A 2-year follow up. Crim Justice and Behav 33(5): 571-596
71. Caldwell MF, McCormick D, Wolfe J, Umstead D (2012) Treatment-related changes in psychopathy features and behaviour in adolescent offenders. Crim Justice and Behav 39(2): 144-155
72. Salekin RT, Tippey JG, Allen AD (2012) Treatment of conduct problem youth with interpersonal callous traits using mental models: Measurement of risk and change. Behav Sci Law 30: 470-486

Table 1: Descriptives of main study variables.

	N	*α*	M	SD	Minimum	Maximum	Skewness	Kurtosis
YPI CU	50	.60	36.54	6.05	26	51	.39	-.07
ICU	50	.75	25.86	7.80	6	42	-.07	-.13
SRD: Violent Delinquency	50	.56	2.94	1.33	0	6	-.32	.02
Accuracy: faces								
Angry	37	-	.59	.29	.05	1.00	-.20	-1.13
Fear	37	-	.62	.31	.06	1.00	-.16	-1.31
Sad	37	-	.73	.24	.13	1.00	-.74	.19
Pain	37	-	.57	.36	.00	1.00	-.10	-1.42
Disgust	37	-	.40	.27	.00	1.00	.38	-.34
Happy	37	-	.95	.13	.33	1.00	-3.32	12.49
Accuracy: postures								

Angry	47	-	.49	.27	.07	1.00	.14	-.88
Fear	47	-	.43	.25	.03	1.00	.13	-.50
Sad	47	-	.42	.23	.00	.86	-.08	-.67
Disgust	47	-	.32	.23	.00	.83	.94	.11
Happy	47	-	.63	.22	.10	1.00	-.36	-.10

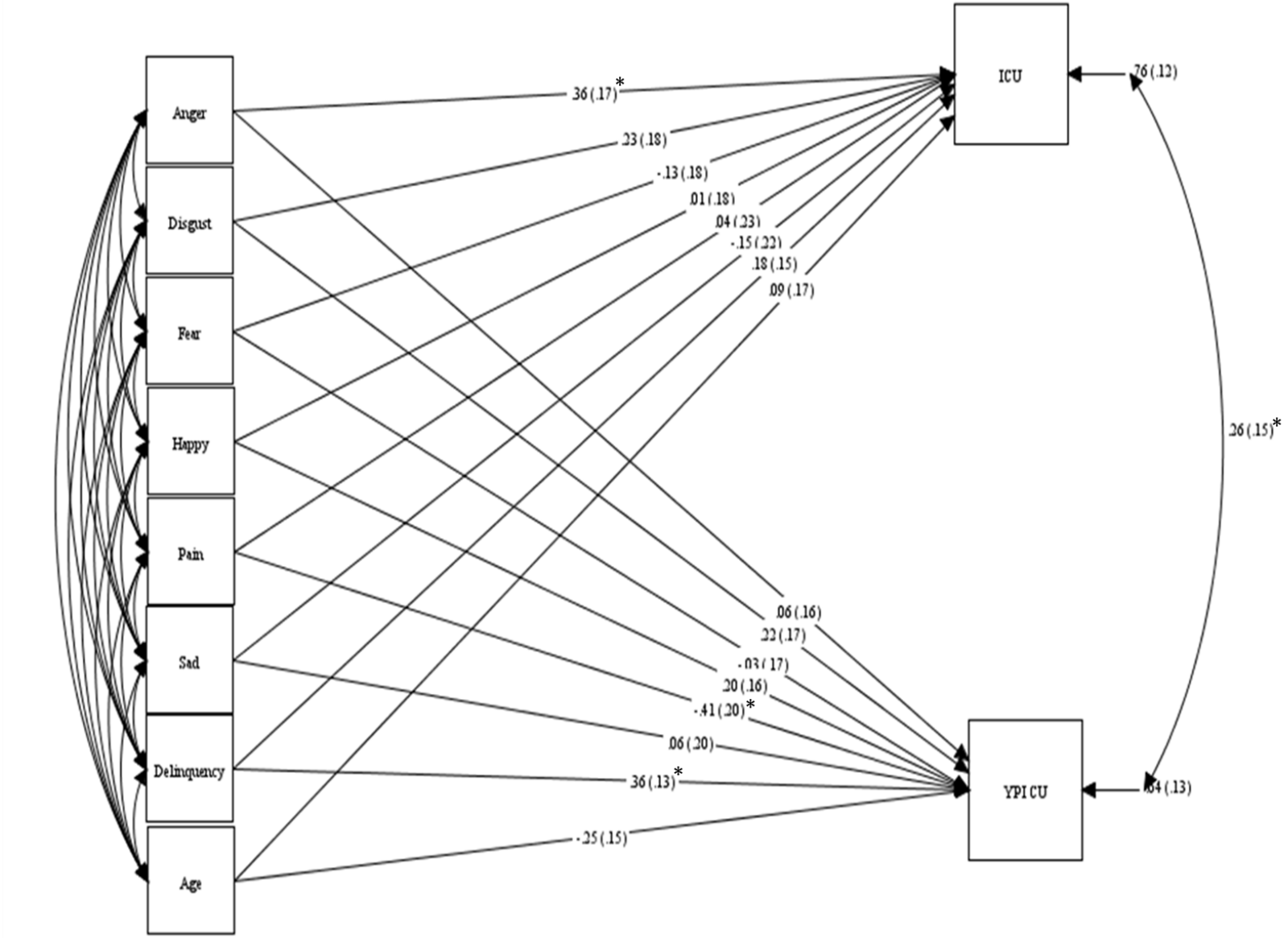
Anger
Disgust
Fear
Happy
Pain
Sad
Delinquency
Age
ICU
YPI CU
.36 (.17)*
.23 (.18)
-.13 (.18)
.01 (.18)
.04 (.23)
-.15 (.22)
.18 (.15)
.09 (.17)
.06 (.16)
.22 (.17)
-.03 (.17)
.20 (.16)
-.41 (.20)*
.06 (.20)
.36 (.13)*
-.25 (.15)
.76 (.12)
.26 (.15)*
.04 (.13)

Figure 1. Standardized solution of betas (SE) in the model of callous-unemotional traits regressed on emotional faces (using the callous-unemotional (CU) subscale of the Youth Psychopathic traits Inventory [YPI] and the Inventory of Callous-Unemotional traits [ICU]). Note: *p < .05.

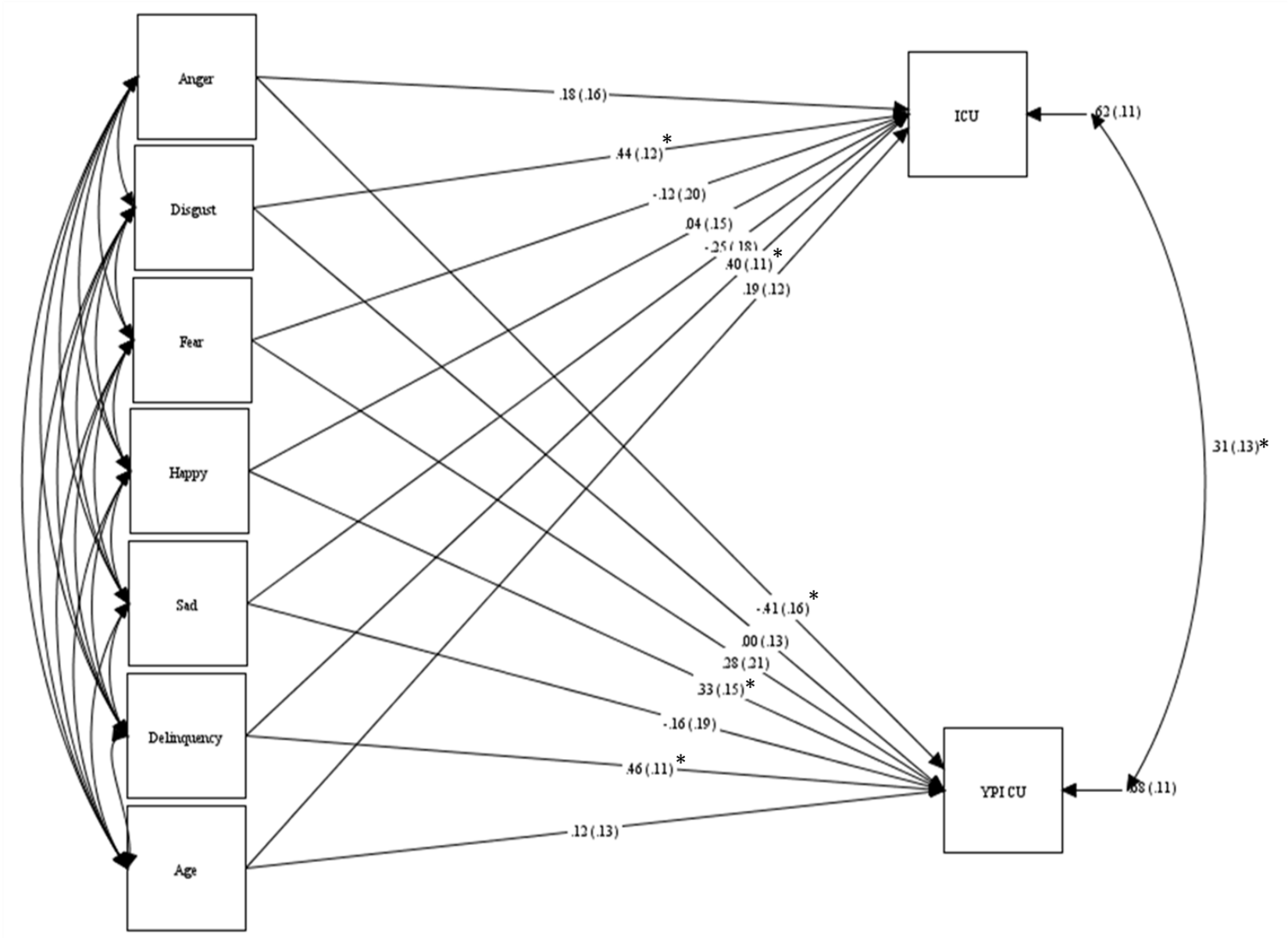
Anger
Disgust
Fear
Happy
Sad
Delinquency
Age
ICU
YPI CU
.18 (.16)
.44 (.12)*
-.12 (.20)
.04 (.15)
-.25 (.18)
.40 (.11)*
.19 (.12)
-.41 (.16)*
.00 (.13)
.28 (.21)
.33 (.15)*
-.16 (.19)
.46 (.11)*
.12 (.13)
.62 (.11)
.31 (.13)*
.88 (.11)

Figure 2. Standardized solution of betas (SE) in the model of callous-unemotional traits regressed on emotional poses (using the callous-unemotional (CU) subscale of the Youth Psychopathic traits Inventory [YPI] and the Inventory of Callous-Unemotional traits [ICU]). Note: *p < .05.